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ABSTRACT

This booklet, one of six in the Living Things Science series, presents activities about matter and energy which address basic "Benchmarks" suggested by the American Association for the Advancement of Science for the Living Environment for grades 3-5. Contents include background information, vocabulary (in English and Spanish), materials, procedures, extension activities, and worksheets. The worksheets are presented in both English and Spanish versions. Suggestions for use of the activities include using student grouping, a related reading center, and journal keeping. Activity names are: "Food Mountain," "Food Journal," "Are We Really Vegetarians?," "Human Food Chain Demonstration," "Designer Leaves," "Energy for Life," "Decomposition," "Plastic or Paper," "Discovering Mold," and "Fungi Hunt." Lists of fiction and non-fiction readings are included. (MKR)

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INVITATIONS

TO

THE MATTER-ENERGY CYCLE

Teacher Friendly Science Activities

with reproducible handouts in English and Spanish

Grades 3-5

Carole Ann Camp, Editor

LIVING THINGS SCIENCE SERIES

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Teacher-Friendly Science Activities

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Grades 3-5

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LIVING THINGS SCIENCE SERIES

Ash Grove Press, Inc.

LIVING THINGS SERIES

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Heredity: Generation to Generation

Cells: Life's Building Block

Interdependence: Caught in the Web

The Matter-Energy Cycle

Evolving

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TABLE OF CONTENTS

Introduction	1
Related Reading for Invitations Center	3
Vocabulary	5
Invitation 1 FOOD MOUNTAIN	7
Invitation 2 FOOD JOURNAL	13
Invitation 3 ARE WE REALLY VEGETARIANS?	16
Invitation 4 HUMAN FOOD CHAIN DEMONSTRATION	17
Invitation 5 DESIGNER LEAVES	20
Invitation 6 ENERGY FOR LIFE	23
Invitation 7 DECOMPOSITION	27
Invitation 8 PLASTIC OR PAPER?	30
Invitation 9 DISCOVERING MOLD	34
Invitation 10 FUNGI HUNT	38
Science Journal Handouts	40

INVITATIONS TO MATTER AND ENERGY

INTRODUCTION

The living environment can spark curiosity and generate enthusiasm about plant and animal behavior. By participating in *Invitations to Matter and Energy,* students will gain an understanding of matter and energy and the transfers taking place between them. Organisms relate and are tied to one another in the physical environment, using exchanges and transformations of matter and energy.

The flow of matter and energy is a constant occurrence. Substances generate, grow, die, decompose and become nourishment for a new substance. All living things fit somewhere in this cycle. While every living thing needs water, some things can survive without direct light or food.

Animals need water, oxygen, and food to survive, but some can live without direct light. Plants need water, sunlight, and carbon dioxide to produce their own food which takes on the form of sugars.

Living plants and animals are dependent upon one another. Each one is crucial for the other's survival. Equally important is the death of substances. Without death, certain organisms would not be provided with the nourishment they need for survival.

From the smallest of molecules to the largest of ecosystems, matter and energy are found in the various levels of the biological organization. To best illustrate what these entail, the study and use of food webs is strongly encouraged. In visualizing "what eats what," students will comprehend how matter is transferred from one form to another through exchanges made in nature by plants and animals.

By the end of the second grade, the basic concept of food chains should have been introduced showing that plants need sunlight and water to grow and that animals need water, other plants and/or animals to survive. In addition to an understanding of food chains and food webs, students should also have an understanding of recycling. Discussion of recycling should generate the idea that matter continues to exist even though it changes from one state or form to another but never truly disappears.

By allowing students to participate in activities and make inferences about the living world, we can foster their understanding of how important the flow of energy is in all of its forms and how these sources remain vital for our continued existence.

Throughout these invitations, students should be made aware that things (substances) may change shape (form) and move to different places, but they never just appear from nowhere or disappear to nowhere.

Discussion starters can include "the chicken or the egg" controversy. "Where did the dinosaurs come from?" "Why did they die?" or "How did fungi or plants originate?" These kinds of questions will enable students to see how diverse and dependent plant and animal life really is.

Have students consider and list what kinds of plants and animals live in a forest, desert or plain.

Each of these invitations has been designed to be used independently. It is not necessary to go in order. Teachers are encouraged to adapt these invitations for their unique settings. All of science and life is interdependent; however, Invitations 1-3 relate generally to Concept 1; Invitations 4-6 relate to Concept 2; and Invitations 7-10 relate to Concept 3. Invitation 1 also demonstrates Concept 3.

SCIENCE JOURNAL

The students are encouraged to keep journals of their observations. They are also encouraged to reflect on their observations as they participate in the activities in this invitation. The students can create their own format for their science journals, the teacher can suggest a format, or the reproducible pages throughout this book can be used.

CONCEPTS

Due to the nature of the interdependence of all things, the invitations in this book address all of the following concepts at some level. However, some invitations highlight one or more of the concepts. Those concepts will be identified by bold print in the concept section of each invitation.

1. Most foods can be traced back to plants.
2. In order for plants and animals to stay alive and prosper, a source of energy is required.
3. Organisms grow, die and decay. This process provides the environment for other organisms to grow, die, and decay.

CLASSROOM MANAGEMENT

The activities in these INVITATIONS can be managed in a variety of ways. However, we recommend that students have many opportunities to work together in groups of 3-4 students. By sharing and working together, students will be able to value their fellow students contributions, as well as begin to realize that the process they are experiencing is similar to the way scientists work.

If it is possible in your classroom, identify one area, desk or table, as the INVITATIONS CENTER. Include in this location, books from the list below and extension activities. Please follow the guidelines for your school district and the recommendations from the National Science Teachers Association on living things in the classroom.

Many of the activities in this unit are similar in some ways, but focus on different aspects of the concepts. Many activities involve observations over time. You may choose to have all of the students do all of the activities, or have each group of students focus on a different activity sharing observations as they go along.

Some aspects of these invitations are more appropriate for the younger students, while other aspects are better for older students. Teachers should feel free to adapt each activity for their particular students.

RELATED READING FOR INVITATION CENTER

FICTION

Baker, Jeannie. *Window*. New York, Greenwillow Books, 1991.

Bjork, Christina. Illustrated by Lena Anderson. *Linnea in Monet's Garden*. New York, R & S Books. 1987.

Bliss, Corrine Demas. Illustrated by Ted Lewin. *Matthew's Meadow*, 1st Edition. San Diego, Harcourt Brace, 1992.

Buscaglia, Leo F. *The Fall of Freddie the Leaf: A Story of Life for All Ages*. Thorofare, New Jersey, C.B. Slack, 1982.

Cooney, Barbara. *Miss Rumphius*. New York, The Viking Press, 1982.

dePaola, Tomie. *Bill and Pete Go Down the Nile*. New York, Putnam, 1978.

Fife, Dale. Illustrated by Jim Aronsky. *The Empty Lot*. Boston, Little Brown, 1991.

Fife, Dale. Illustrated by Marie DeJohn. *Rosa's Special Garden*. Niles, Illinois, A. Whitman, 1985.

George, Jean Craighead. *My Side of the Mountain*. New York, Dutton, 1988.

Himmelman, John. *Amanda and the Magic Garden*. New York, Viking Kestral, 1987.

MacGregor, Ellen and Dora Pantell. Illustrated by Charles Geer. *Miss Pickerell Tackles the Energy Crisis*. New York, McGraw-Hill, 1980.

Mazer, Anne. Illustrated by Steve Johnson. *The Salamander Room*. New York, Knopf, 1991.

Palmisciano, Diane. *Garden Partners*. New York, Atheneum Press, 1989.

Peet, Bill. *The Wump World*. Boston, Houghton Mifflin, 1970.

Seuss, Dr. *The Lorax*. New York, Random House, 1971.

St. Antoine, Sara. *The Green Musketeers and the Fabulous Frogs*. NewYork, Bantam/Skylark, 1994.

Thompson, Julian F. *Gypsyworld*. New York, H. Holt, 1992.

Van Allsburg, Chris. *Just A Dozen*. Boston, Houghton Mifflin, 1990.

Yolan, Jane. Illustrated by Laura Regan. *Welcome to the Green House*. New York, Putnam Publishing Group, 1993.

NON-FICTION

Beller, Joel. *Experimenting with Plants: Projects for Home, Garden, and Classroom.* New York, Arce Publishing, Inc., 1983.

Cherry, Lynne. *A River Ran Wild: An Environmental History,* 1st ed. San Diego, Harcourt Brace Javanovich, 1992.

Foster, Joanna. *Cartons, Cans, and Orange Peels: Where Does Your Garbage Go?* New York, Clarion Books, 1991.

Hunken, Jorie and The New England Wildflower Society. *Botany for All Ages: Discovering Nature Through Activities Using Plants.* Chester, CT, The Globe Pequot Press, 1989.

Jacobs, Francine. *Breakthrough: The True Story of Penicillin.* New York, Dodd Mead, 1985.

Johnson, Sylvia A. Yuko Sato, photographer. *How Leaves Change.* Minneapolis, Lerner Publications Co., 1986.

Katz, Bobbi. Illustrated by S.D. Schindler. *The Creepy, Crawly Book.* New York, Randon House, 1989.

Koral, April. *Our Global Greenhouse.* New York, F. Watts, 1989.

Krementz, Jill. *A Very Young Gardener.* New York, Dial Books, 1991.

Kumin, Maxine. Illustrated by Arnold Lobe. *The Microscope.* New York, Harper & Row, 1968, 1984.

Lamber, David. *Vegetation.* New York, Bookwright Press, 1984.

Oechsli, Helen & Kelly. *In My Garden. A Child's Gardening Book.* New York, MacMillan Publishing Co., 1985.

Patent, Dorothy Hinshow. Illustrated by William Munoz. *Yellowstone Fires: Flames and Rebirth.* New York, Holiday, 1990.

Penner, Lucille Recht. *Eating Plates: A Pilgrim Book of Food & Manners.* New York, Macmillan, 1991.

Perl, Lila. *Junk Food, Fast Food, Health Food: What America Eats and Why.* New York, Houghton-Mifflin, Clarion Books, 1980.

Pringle, Laurence. *Throwing Things Away, from Middens to Resource Recovery.* New York, Thomas Y. Crowell Co., 1986.

Stone, Lynn. *Wetlands Food Chain.* Vero Beach, Florida, Rourke Corp., 1989.

Timberlake, Lloyd. Illustrated by Ron Hayward. *Famine in Africa.* New York. Gloucester Press, 1986.

Tomas, M. J. and E. Soothill. *Discovering Birds of Prey.* New York, Bookwright Press, 1986.

Versfeld, Ruth. *Why Are People Hungry?* New York, Gloucester Press, 1988.

Vogel, Carole Garbuny and Kathryn Allen Goldner. *The Great Yellowstone Fire,* Vol. 1. Boston, Little Brown, 1990.

Wilcox, Charlotte. Illustrated by Jerry Bushey. *Trash!* Minneapolis, MN, Lerner Publications, 1989.

VOCABULARY

The teacher is encouraged to help students develop their own unique set of vocabulary words depending on the students interest, experience, and ability. The following words are primarily for the teacher.

antibiotic: germ killing substance produced by bacterium, mold or other fungus

antibiótico: la sustancia producida por un bacterium, moho, o otro hongo, que mata microbios

autotroph: organism capable of organizing organic molecules from inorganic molecules; self-feeders

autotroph: un organismo capable de organizar moléculas orgánicas de moléculas inorgánicas

carnivore: an animal that feeds on other animals

carnívoro: un animal que come otros animales

chlorophyll: green pigments needed for food manufacture in plants

clorofila: los pigmentos verdes necesarios para la manufactura de alimento en plantos

compost: decomposed organic material resulting from composting process; also referred to as humus

abono: materia orgánica descompuesta; También llamado humus

consumers: an organism that obtains nutrients from other organisms

consumidores: un organismo que obtiene nutrientes de otros organismos

decomposers: organisms, such as bacteria and fungi, that use the material from dead organisms as a food source

decomposers: organismos, tal como microbios y hongos que consumen materia de organismos muertos

ecosystem: a group of organisms and their physical environment and all the interactions between them

condiciónes ambientales: un grupo de organismos y su entorno y todas sus interacciónes

energy: ability to do work

energía: la capacidad de trabajar

food chain: the transfer of energy from producers to consumers as organisms feed on one another

cadena de alimento: la transferencia de la energía del sol de productores a consumidores cuando organismos se comen uno al otro

food pyramid: a pyramid of biomass with the food producers forming the base and the top carnivore at the apex

pirámide de alimento: una representación de biomasa, con los productores de alimento forman la base y el carnívoro superior en la punta

fungi: a unique group that generally feed on dead organic matter; examples of fungi are mushrooms, molds, and yeast

hongo: un organismo que come generalmente materia organica muerta; por ejemplo champiñones, moho y levandura

herbivore: plant eating animal

herbívoro: un animal que come plantas

heterotroph: organism that cannot synthesize its own nutrients and must obtain them ready-made

heterotroph: un organismo que no puede sintetizar sus propios nutrientes y debe obtenerlos hecho

humus: organic material resulting from decay of plant and animal matter

humus: materia organica que resulta del decaimiento de plantas y animales

mold: a fuzzy growth caused by fungus on plant or animal matters that is damp or decaying

moho: un crecimiento velloso producido por hongo en materia de plantas o animales que es húmeda o decayendo

mushroom: a rapidly growing small fleshy fungus that has a stalk topped with a cap of various shapes

champiñon: un pequeño hongo carnoso que crece rapidamente y que tiene un tallo encabezado con una tapa de diversas formas

omnivore: a heterotroph that feeds on both plants and animals

omnívoro: un organismo que se alimenta a la vez en plantas y animales

penicillin: a chemical substance used in treating certain diseases, which is derived from a fungus growing as green mold

penicilina: una sustancia química utilizada en curando unas enfermedades que es derivada de un hongo que crece como moho verde

preservative: a substance added to food to keep it from spoiling

preservativo: una sustancia añadida a los alimentos para impedir degeneración

primary consumer: an animal that feeds on plants; an herbivore

consumidor principal: un animal que alimenta en plantas; un herbívoro

producers: an organism that makes its own food from inorganic compounds; an autotroph

productores: un organismo que produce su mismo alimentación de compuestos inorganicos un "autotroph"

rust: a disease of plants that makes brownish spots on stems and leaves

oxida: una enfermedad de plantas que hace manchas morenas en tallos y hojas

secondary consumers: in a food chain, a carnivore that feeds on primary consumers, or herbivores

consumidores secudarios: en una cadena de alimento, un carnívoro que alimenta en consumidores principales, o los herbívoros

yeast: a yellow frothy substance made up of fungi, used in baking to make dough rise

levadura: una sustancia espumosa amarilla hecho de hongos, utilizado en hornear para hacer levantar pasta

12

INVITATION 1

FOOD MOUNTAIN

BACKGROUND

All living things need some form of energy in order to survive. Energy sources can be sunlight, water, and food. Food sources include plants and animals.

Autotrophs make all the organic nutrients they need from inorganic compounds. An inorganic compound is one that does not contain carbon. Most autotrophs carry on photosynthesis. Autotrophs provide all the food for heterotrophs. Heterotrophs cannot make their own nutrients.

Heterotrophs include herbivores, carnivores, and saprophytes. Herbivores are animals that feed only on plants. Omnivores feed on plants and animals. Saprophytes obtain nutrients by breaking down the remains of dead plants and animals. Bacteria and fungi are saprophytes.

In almost any ecosystem there are producers, consumers, and decomposers. Autotrophs are producers because they can produce food from inorganic compounds. Heterotrophs are called consumers and saprophytes are called decomposers.

Within an ecosystem there is a pathway of energy flow that begins with the producers, namely plants. Herbivores are primary or first level consumers. Carnivores are secondary or second level consumers. An example of a simple food chain is grass, mice, owl, fungi. The grass is the producer, the mouse is the primary consumer, the owl is the secondary consumer. When the owl dies, the fungi decompose the wastes and remains of all organisms in the system. While using these products for their own metabolism, they break down organic compounds into inorganic ones and make substances available for reuse. Decomposers are an essential link in every food chain or food web.

This exercise will demonstrate that each organism has a role in the food mountain (pyramid) and is vital to the survival of the organism on the next level up the mountain. It should also be noted that it takes a great amount of food on the lower levels to satisfy the organisms on the upper levels. At each level the energy available is only about 10% of the energy at the level below it.

CONCEPTS

- **Most foods can be traced back to plants.**
- In order for plants and animals to stay alive and prosper, a source of energy is required.
- Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.

MATERIALS

- Handouts on pages 9-12
- Nature magazines, for example, *National Geographic*, *National Wildlife*, *Ranger Rick*, *Your Big Backyard*
- Green yarn, cut to simulate blades of grass, about 1.5 inches

PROCEDURE

1. In preparation, make a demonstration model of a large triangle for your wall or chalkboard. In addition make large copies of the animals on pages 11 and 12. You may want to color and laminate them.
2. Make a copy of pages 9 and 10 for each student or group of students. Have students cut each paper along the diagonal line. Trim the edges from the side of the triangles. Tape each triangle from page 9 to each triangle on page 10. (See diagram A.) NOTE: Each student will have two large triangles. One is to be used with the animals on page 11 and 12. One is to be used for their own research.

Initiate discussion about what owls eat. Attach a picture of an owl to the top of the pyramid.
Have students predict how many small animals it would take to keep an owl alive for one day.
Have students attach that many small birds to the second level of the pyramid. Ask students to predict how many insects it would take to keep a small bird alive for a day. Attach that many insects to the third layer of the mountain.
Repeat, asking students to predict how much grass it takes to keep a grasshopper alive for one day. Put that number of blades of grass on the bottom layer of the mountain for each insect on the previous level. The ratio of one level to the next is approximately 1:10. Allow students to have their own predictions. It does not matter if they predict 1 or 1 billion. The number will be adjusted as the activity progresses.
Divide the class into research groups. Group one: How many small birds and animals are needed to keep an owl alive for 1 day? Group two: How many insects will keep a small bird alive for 1 day? Group three: How much food is required to keep an insect alive? Share results with the class. Individuals can make adjustments to their predictions.
Have each student select an animal that is high on the food chain, not humans, and find a picture of the animal in the magazines. You may want students to select animals from pictures available.
Have students glue the picture on the top rung of the second pyramid.
Have students research the food requirements necessary to keep that animal alive for one day. Find pictures of these animals or plants. For example, if it takes 10 codfish to keep a leopard seal alive for one day, find pictures of 10 codfish.
Proceed down the chain. It may be difficult to find 100 pictures of krill (what codfish eat). Students may have to draw the pictures, or you may want to make creative use of computers or copy machines.
In journals, have students reflect on what happens to the animal at the top of the pyramid when it dies. Where would they put decomposers on the food mountain? NOTE: When a secondary consumer at the top of the food mountain dies, fungi in the air and on the ground begin to feed off the dead animal, thus breaking it down or decomposing it. Once this occurs, the nutrients from the broken down matter trickle down the mountain providing food for the plants and grasses at the bottom of the mountain.

EXTENSION ACTIVITIES

Create a food mountain with human beings at the top of the mountain. Research and calculate how much food each level needs to produce to keep a human alive.
Create a vegetarian food mountain with human beings at the top of the mountain. Compare the resources needed to keep a human alive with the non-vegetarian model.
Calculate how much food is needed at each level to keep the humans in your school or community or state alive for one day, one month, one year.

QUESTIONS FOR DISCUSSION OR JOURNAL REFLECTION

What happens to the food chain when human intervention or an environmental disaster destroys one of the links?
What occurs when there is a limited supply of a certain link?
Will links adapt to a new food source? Which ones? Why do you think this is so?
What do you perceive or think might be a threat to any of the links?

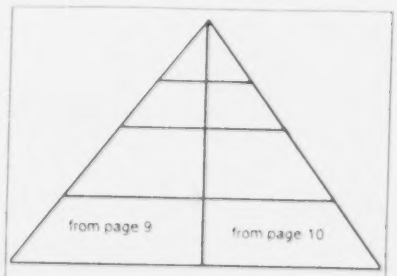
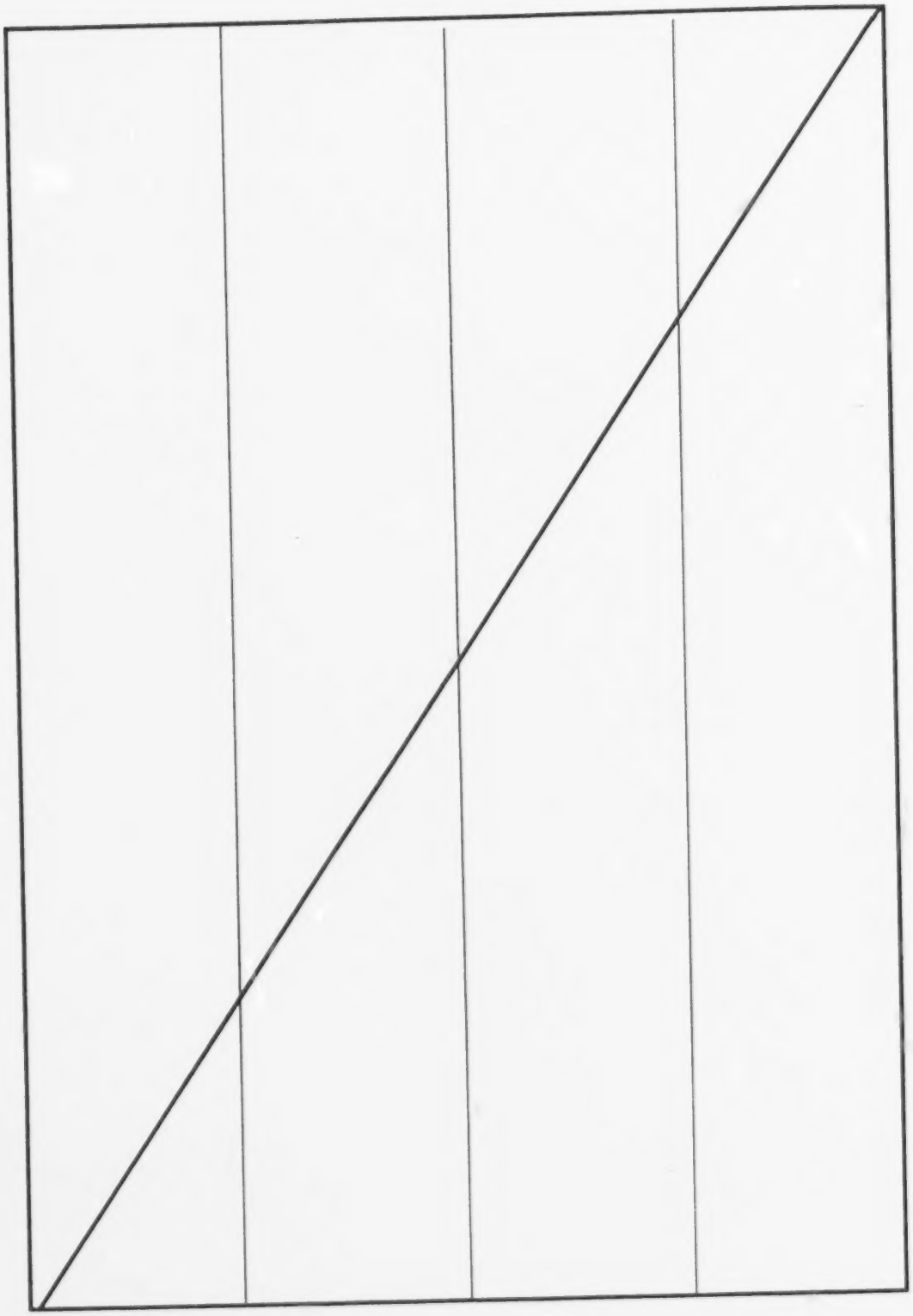
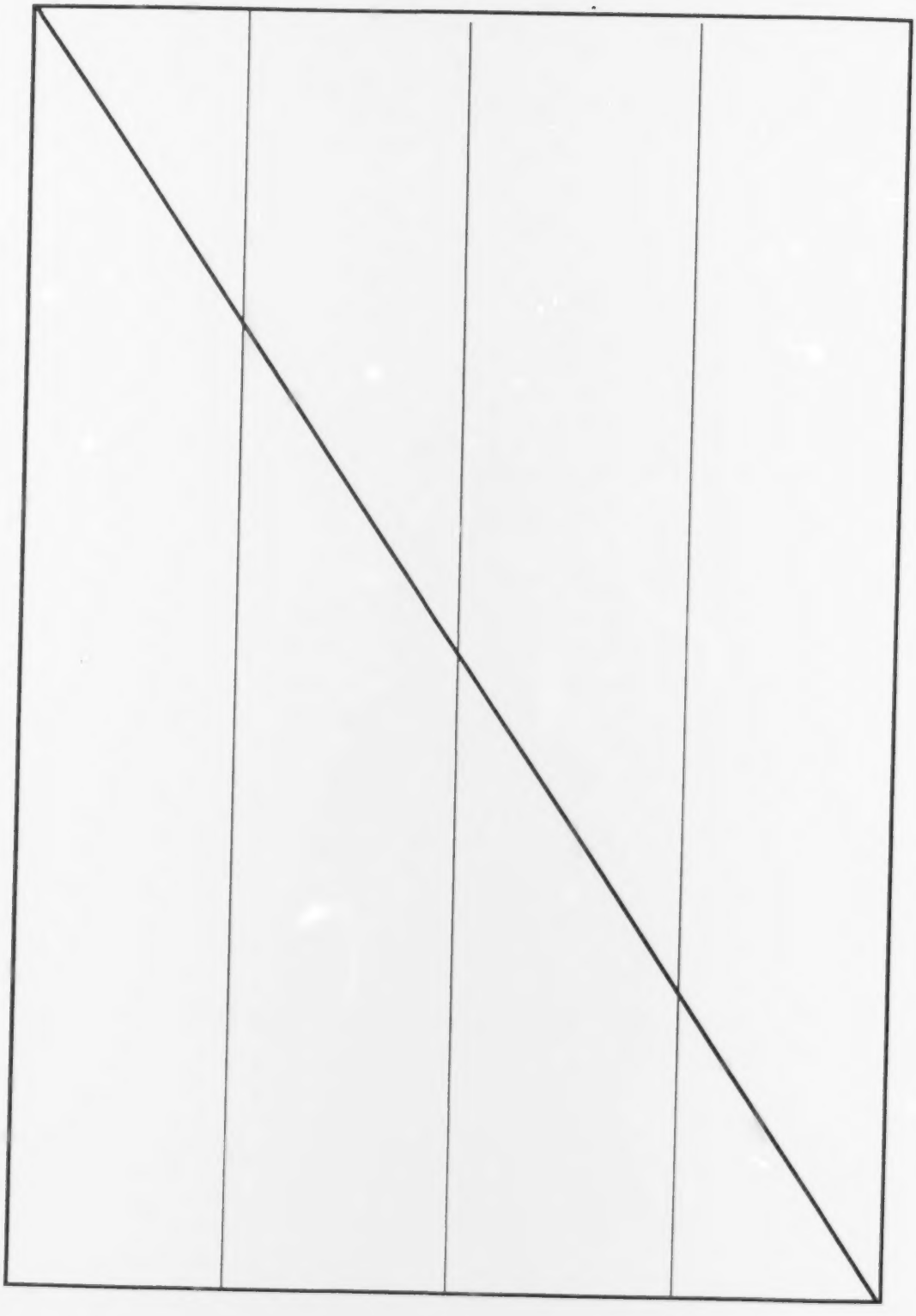
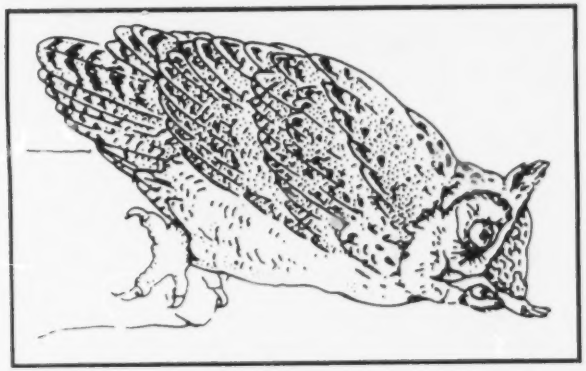


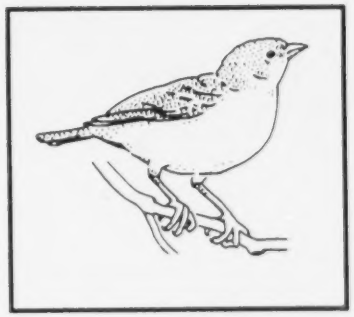
Diagram A

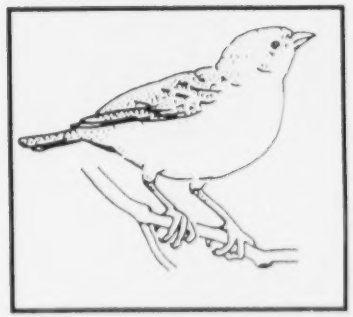


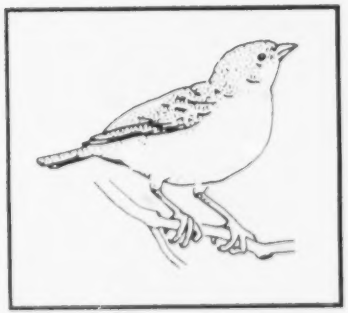


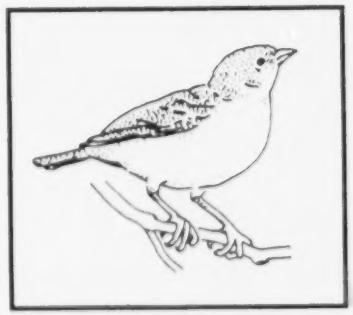
MAKE ONE COPY OF THIS PAGE FOR EACH GROUP

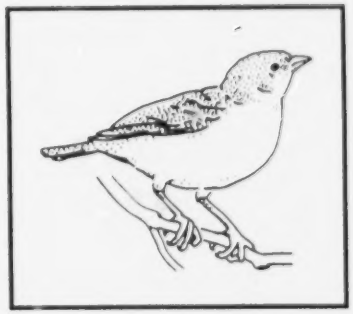


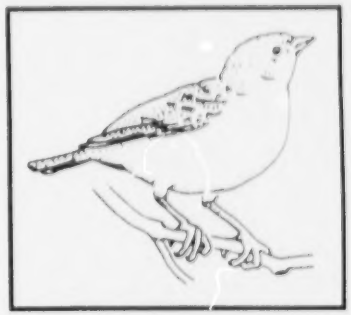


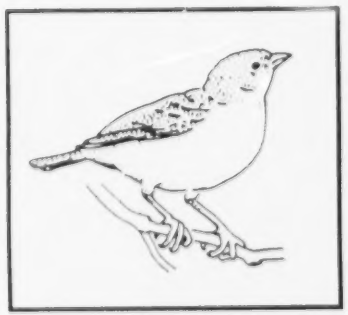


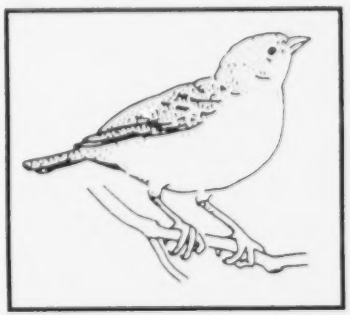


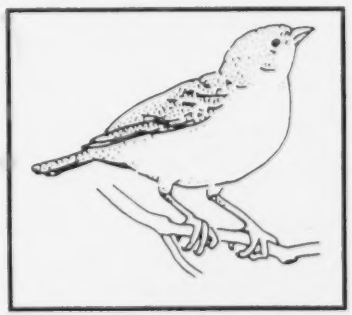


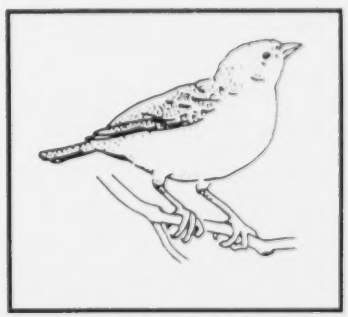












MAKE 5 COPIES OF THIS PAGE FOR EACH GROUP.

INVITATION 2

FOOD JOURNAL

BACKGROUND

Plants are a major food source for people and animals alike. We never know how much we rely on the intake of plants until we have to trace our own food consumption.

Scientists believe plants evolved from single cells floating in open bodies of water. Eventually some cells grouped together to perform special tasks. These tasks included the ability to anchor with roots, grow a stalk for support on land, make their own food, and reproduce. These specialized adaptations allowed plants to invade land. As a result, more land animals evolved because of the ready food source. For hundreds of millions of years, plants have remained a primary source of food for animals. Today, they still remain vital to the survival of all animal species.

Because this is a week long assignment, students progress should be monitored daily to assist them with any difficulty they may be having.

Pinpointing what students consume, especially if eating foods like TV dinners, frozen entrees, parent's casserole, candy bars, or trail mix, can be a difficult task. When questions arise regarding the nature of food, use this opportunity to involve the class in a problem solving task.

The objective of this lesson is for students to realize that almost everything they consume originates from plants. They will be able to gain a better appreciation for the importance of plants and how vital they are for the continued survival of the entire animal kingdom.

CONCEPTS

- **Most foods can be traced back to plants.**
- In order for plants and animals to stay alive and prosper a source of energy is required.
- Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.

HINT: Recording all meals may be difficult for the younger children. Start with in-class snacks.

MATERIALS

- Empty food packaging (can labels, empty boxes and wrappers)

PROCEDURE

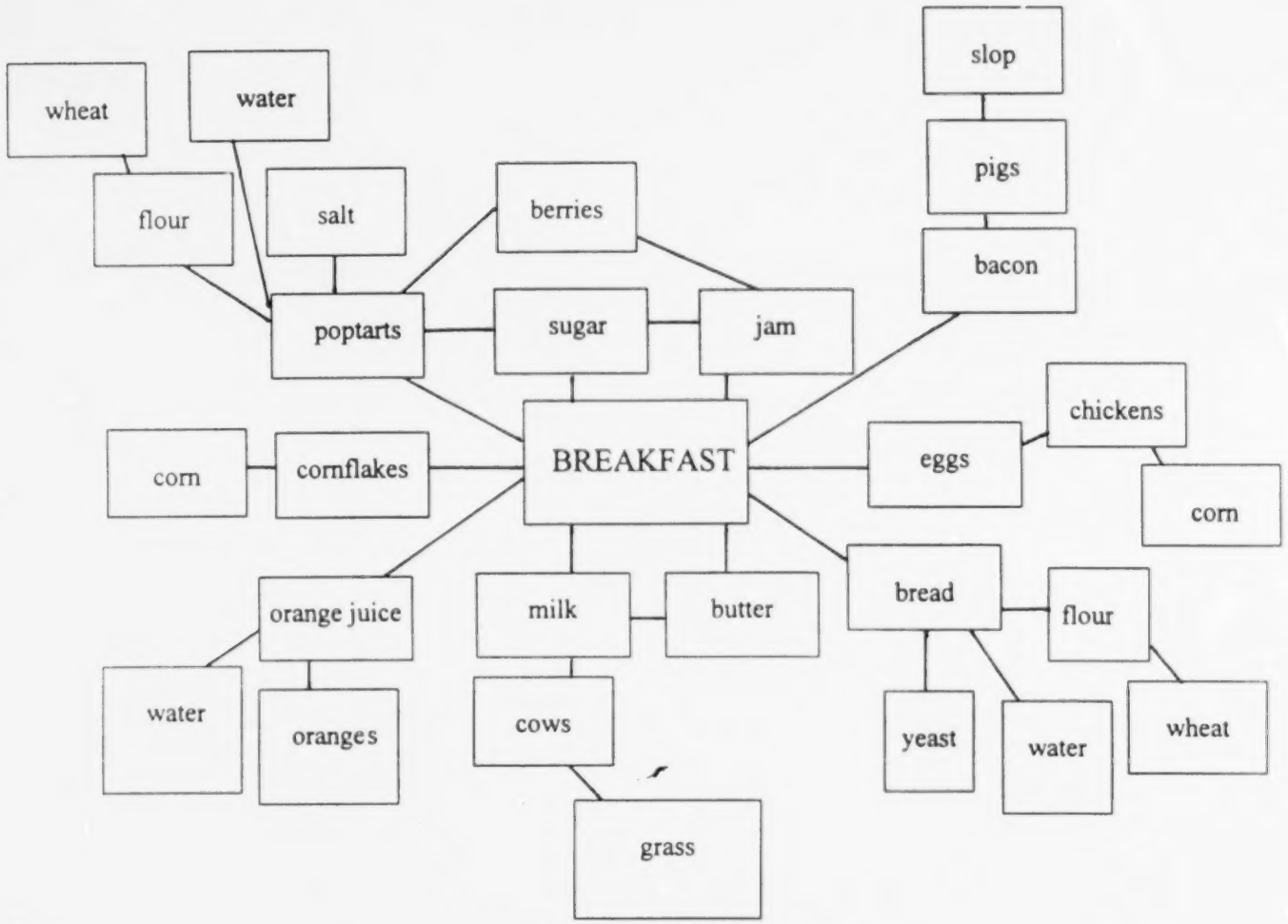
1. Divide students into groups of threes or fours. Each group will explore one of the following topics: breakfast, lunch, dinner or snacks.
2. Using a web or mapping diagram, list all the food consumed by the group during the specific eating period assigned. See sample on page 15.
3. For each item listed ask questions like, "What are the ingredients in it?" or if it is an animal, "What does is eat?" Create a food chain so that the end of each chain is a plant or an inorganic nutrient, like water or salt. Remember, sugar comes from a plant. In some cases, like a "Poptart", the item will have several branches, one ending in wheat, one ending in some kind of berries, one ending in sugar.
4. Share webs with the class.
5. Ask students to keep a food journal for one week. They should try to record everything they eat in their journal including keeping all the labels from packaging as well as recipes.
6. At the end of the week, the students can tally up what they ate and determine how many true plants (fruits/vegetables and grains) they ate and how many foods come from plants indirectly (i.e. meats and dairy products).

7. Have the students analyze the ingredients in all prepared and processed foods. Encourage them to question what they eat if the source is not readily apparent. Discuss food additives and preservatives and what their role is in food production.

EXTENSION ACTIVITIES

- Research the food consumption in a variety of cultures and countries.
- In small groups design a food production system that will eliminate poverty in the world by 2100.
- If there are fast food chains in your area, collect data on how much food is thrown out each day.

SAMPLE BREAKFAST FOOD WEB



INVITATION 3

ARE WE REALLY VEGETARIANS?

BACKGROUND

Plants are considered to be producers, that is, they create their own food. Plants use sunlight, carbon dioxide, water, and minerals in the soil to create sugar, starch, and water. Some of the oxygen may be used by other organisms for respiration. The carbon dioxide produced by these organisms during respiration is then used by plants to make food during photosynthesis. Photosynthesis and respiration form a never-ending cycle. The plants use this supply of sugar and water as the source of nourishment which allows them to survive. Humans do not have this ability. Humans are called consumers. This means that humans need to look outside of their bodies for the nourishment and energy they need to survive. In order to survive, humans eat other living things. The plant community is a valuable resource to humans and other animals because plants provide most of the food. Most food can be traced back to plants in some way. Plants provide the source of energy for the food humans need.

CONCEPTS

- **Most foods can be traced back to plants.**
- In order for plants and animals to stay alive and prosper, a source of energy is required.
- Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.

MATERIALS

- Bulletin board space
- Magazines
- Labels from various food items
- Green yarn or string

PROCEDURE

1. Create a bulletin board that is divided into three sections. The heading over the first section should read, "Derived From Plants." The second should read, "Not Sure." The third should read, "Does Not Come From Plants."
2. Ask students to bring in labels from food items found in their cupboards at home. Allow time in class to browse through the magazines and cut out pictures of food items.
3. Have students attach labels and food pictures under one of the three bulletin board headings.
4. Divide students into groups of 2-3. Remove items from the "Not Sure" column and redistribute equally to each group. Allow time for group discussion and decision making about where items belong. Invite students from each group to place pictures and labels in the appropriate columns on the bulletin board. If any remain in the "Not Sure" column, invite class discussion and then vote. If items are not familiar to students, help clarify what the item is. Continue the process until students feel sure and no items remain in the "Not Sure" category.
5. Next, examine the "Does Not Come From Plants" column. Pictures such as milk and meat products often show up here. Ask the students if these items are in any way connected to plant life. For instance, cows eat plants and grass for energy.
6. When a connection is made, attach a piece of green string from item to plant side of board.
7. Students will find that most of their items can relate back to plants in some way. The green strings will connect the food items to the plants for a visual effect.
8. Now examine the "Derived From Plants" column. Discuss how much of our food is directly supplied by plants.

EXTENSION ACTIVITIES

- Plant flowers around the school or plant a tree.
- Create a garden in the classroom and learn to care for it.
- Plant an herb garden in the classroom.

INVITATION 4

HUMAN FOOD CHAIN DEMONSTRATION

BACKGROUND

It is important for students to understand that the sun is the source of all energy on earth, and that the building materials of life must be used over and over. Food chains are the living channels which conduct energy and nutrients through life while death and decay return them to the soil. In an ecosystem, there are many food chains. Food chains interlock and cross over to form food webs. Decomposers are found at the bottom of the web. Only plants, algae, and some bacteria can use the sun's energy to make food, so they become the producers in the food web. Animals that eat the plants (herbivores) become consumers in the web. These consumers may then be eaten by meat eaters (carnivores and omnivores).

Ecologists use food chains and webs as models to show what they know about energy flow. Ecological pyramids are also used to show important relationships. The species in a layer of the pyramid are alike in what they eat, not in where they come from or in what they look like. Each successive layer depends on those below it for food, and each in turn furnishes food and services to those above it. As one goes up the food chain, there are fewer animals at that layer. A food web is a picture of all the food chains in a community. For example, in a field there would be hundreds of food chains that are interwoven to show the energy pathways. Food webs can be very complicated. It is important for students to understand that they are part of food chains and webs. Our lives also depend on sunlight and green plants. We are not separate from other life on this planet, we are just one part of the whole.

The following activity is a mini-simulation using students to play the parts of the sun, rain, plants, rabbit, and fox.

CONCEPTS

- Most foods can be traced back to plants.
- **In order for plants and animals to stay alive and prosper, a source of energy is required.**
- Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.

MATERIALS

- Pictures: plant, rabbit, and fox
- Chains of various colors, yellow, green, blue, red If using paper, make chains ahead of time.
- Unsweetened powered fruit drink
- Sugar
- Signs: SOIL, NUTRIENTS, SUN, RAIN, ENERGY
- Glasses of various sizes (large and small)

PROCEDURE

1. Clear a large area in your room. Have one student stand on a chair wearing a sign that says "SUN." The sun's job is to radiate energy to our food chain. The sun holds a large container of sugar that has been labeled "ENERGY" in one hand, and a pitcher of water labeled "RAIN" in the other hand. Hang a yellow chain from that student.

2. Another student represents soil. He/she wears a sign that says "SOIL". This student holds a glass containing powdered fruit drink and labeled "NUTRIENTS." The sun now pours "ENERGY" and "RAIN" into the soil's glass. The roots of plants are now able to absorb the nutrients from the soil. Link chain to soil.

3. Have another student represent a plant by wearing a picture of a plant. The plant now takes the glass labeled "NUTRIENTS" from the soil and drinks

it. The nutrients have now been passed to the plant. Link the yellow chain from the sun to the plant.

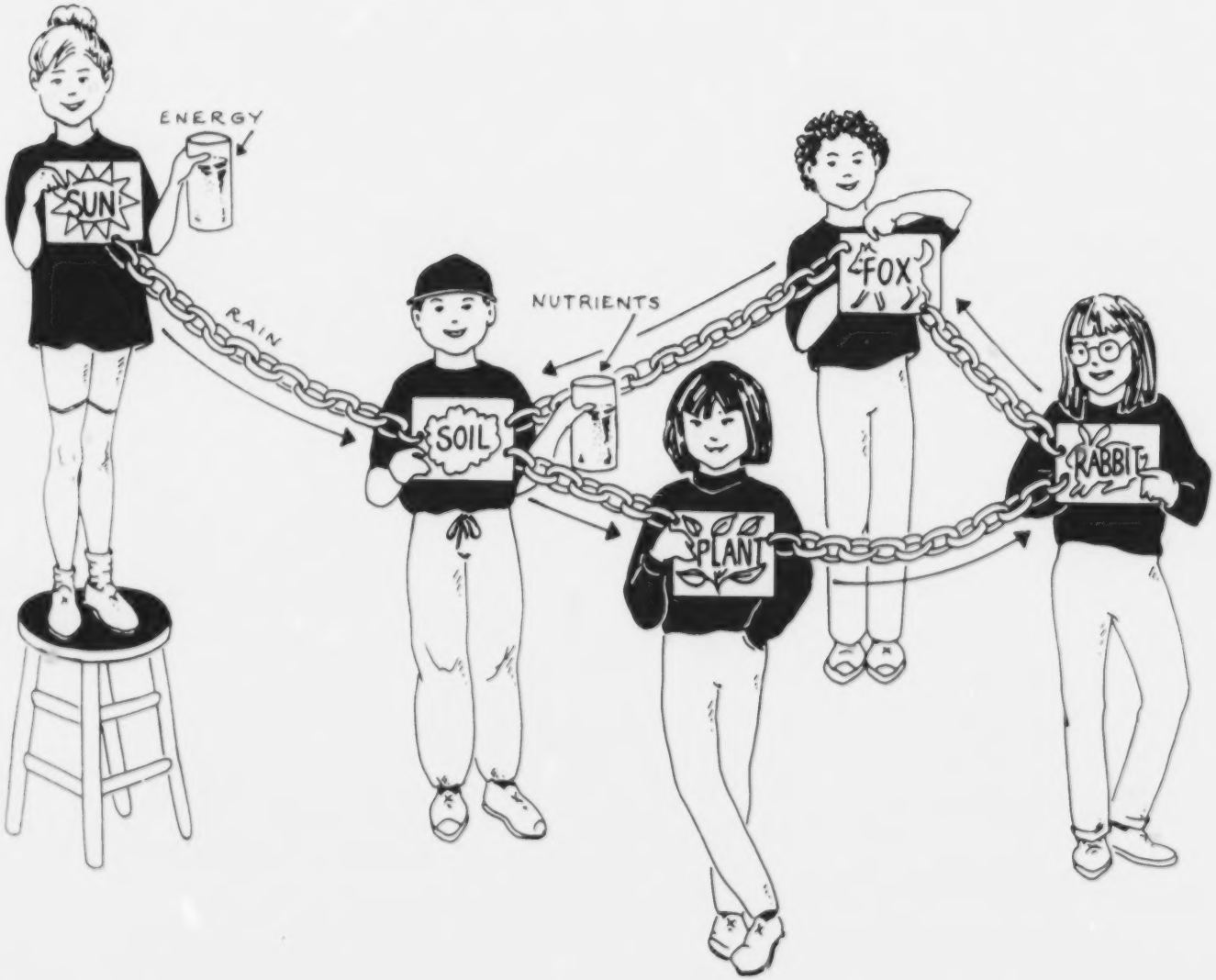
4. Attach a green chain to the other side of the plant. Have another student represent a rabbit by wearing a picture of a rabbit. The green chain is now linked to the rabbit. The student "rabbit" now takes the nutrient label from the plant. This now shows the nutrients being passed along the food chain. Attach a blue chain to the other side of the rabbit.

5. The next student is brought into the chain wearing a picture of a fox. The blue chain goes from the rabbit to the fox. The nutrient sign is now passed to the fox demonstrating the fox eating the rabbit. Discuss the fact that the fox is eventually going to die returning the nutrients to the soil. A red chain is attached to the other side of the fox and the link is made back to the soil. Once again the nutrient sign is passed along.

6. Discuss and review each link along the food chain. Talk about where most of the nutrients are located in the chain.

EXTENSION ACTIVITIES

- Plant grass in a terrarium and have students bring in grasshoppers. After observing them, introduce a praying mantis. Students can introduce other insects into the terrarium. Observe and record observations over several weeks. Insects eating insects may generate a wide variety of responses from the students. Death is a natural part of the food chain.
- Older students may reflect on the difference between death as a natural part of the life cycle and needless killing of plants and animals.


ENERGY
SUN
RAIN
SOIL
NUTRIENTS
PLANT
FOX
RABBIT

INVITATION 5

DESIGNER LEAVES

BACKGROUND

Sunlight stimulates the process of photosynthesis in plants. Photosynthesis is the process plants use to convert carbon dioxide and water into carbohydrates and oxygen. This process is fueled by energy from the sun. Chlorophyll is the green pigment which absorbs the light. Photosynthesis transforms sunlight energy into chemical energy. There are two processes involved in photosynthesis: light reactions and light-independent reactions. Light reactions increase energy to the system. Glucose is formed by using the energy in light-independent reactions.

Everything that is living requires some source of energy. For plants, that source is the sun in combination with minerals, carbon dioxide, and water. If an energy source is removed, plants will die unless they can adapt and find some other energy source. This activity will help children understand the importance of energy sources for life.

CONCEPTS

- Most foods can be traced back to plants.
- **In order for plants and animals to stay alive and prosper, a source of energy is required.**
- Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.

MATERIALS

- Plants that require direct sun, partial sun, and shade. A garden shop will help you with your selection. Try to find plants of each variety that have large leaves.
- Aluminum foil
- Wax paper
- Plastic wrap
- Copies of pages 21 or 22 for each student

PROCEDURE

1. Divide students into groups of 3 or 4.
2. Give each group of students a set of plants.
3. Have students cut different shapes smaller than the leaves from the paper, aluminum foil, wax paper, and plastic wrap.
4. Carefully attach the shapes to the leaves.
5. Put each plant in its preferred location. Water the plants as needed.
6. Have the students predict what might happen to the different kinds of leaves.
7. After two weeks, carefully remove the shapes.
8. Have the students record observations and reflections in their journals.
9. Have the students predict what will happen if the shapes are removed.
10. Remove the shapes and put the plants back in their preferred location.
11. Have the students record their observations in journals daily for two weeks. Reflect on any discrepancies between predictions and observations. Reflect on how the different kinds of plants responded.

EXTENSION ACTIVITIES

- Write a story about a planet that revolves around the sun in such a way that only one half of the planet gets sun and the other half never gets any sun.
- Several billions of years ago, the by-product of photosynthesis was sulfur. No oxygen gas existed in the earth's atmosphere for at least three billion years. Design the planet earth as it would look now, if oxygen-releasing photosynthesis had not evolved.

OBSERVATIONS FOR DESIGNER LEAVES

Plant Biologist:_____
Plant type:_____

Conditions:
Date shapes attached:

Observations of plant leaves two weeks after shapes were attached.

FOIL	WAXED PAPER
PLASTIC WRAP	PAPER

Observations of plant leaves two weeks after shapes have been removed.

FOIL	WAXED PAPER
PLASTIC WRAP	PAPER

Observaciónes Para "Hojas Diseñadas"

Biólogo de Plantas:_____
Tipo de planta:_____

Condiciones:
Fecha en que formas son incluidas:

Observaciónes de hojas dos semanas despues de que formas han estado incluidas.

LÁMINAS DE ALUMINIO	LÁMINAS DE CERA
LÁMINAS DE PLÁSTICO	PAPEL

Observaciónes de hojas dos semanas despues de que formas han estado retirados.

LÁMINAS DE ALUMINIO	LÁMINAS DE CERA
LÁMINAS DE PLÁSTICO	PAPEL

INVITATION 6

ENERGY FOR LIFE

BACKGROUND

Energy is required in order for organisms to carry out their life processes. Without energy, organisms die. The sun is the primary energy source. Plants convert the energy from the sun into food for other organisms. Conditions like the amount of sunlight available, the temperature, and the water supply affect plants in a variety of ways. This "invitation" demonstrates how changes in these conditions affect grass. If you live in an area where grass is not easily available, try this activity with a plant that is readily available where you are.

When removing plants from their environment for classroom observations, encourage students to be thankful to the plants for contributing to their understanding of their world.

HINT: Plan to do this invitation when grass is easily available in your climate, or plant grass in the fall for spring use.

CONCEPTS

- Most foods can be traced back to plants.
- **In order for plants and animals to stay alive and prosper, a source of energy is required.**
- Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.

MATERIALS

- Assorted clean jelly or baby food jars with labels removed (enough for the whole class)
- 1 piece of plywood approximately 8 1/2" x 11" for each group
- 1 large shoebox and lid for each group
- A patch of green grass or cut field where students can experiment
- 2 plastic food storage containers (4 quart size or larger) for each group
- Copies of pages 25 or 26 for each student

PROCEDURE

As a large group, brainstorm everything that is necessary for things to grow. In journals reflect on what happens to plants when heat, light, and water are taken away or increased. Each of the following activities can be done concurrently or sequentially. Each activity takes at least 3 weeks of careful observation. Each student or group of students can do all of the activities, or each group can do a different part of the set, comparing and sharing observations at the end of the observation period. Some of the activities take place outside, and some require removing a section of grass and bringing it into the classroom. Before cutting up and using the school lawn, be sure to consult your school administrator.

This invitation has 6 distinct observation activities and all follow the same procedure. The observation sheet on page 25 or 26 may be helpful.

General Procedure

1. Observe grass.
2. Predict what will happen under each of the conditions listed below.
3. Make observations every 3 days for 3 weeks.
4. Reflect on observations.
5. Replace grass to original site if removed.
6. Make predictions about what will happen to the replaced grass.
7. Make observations every 3 days for 3 weeks.
8. Reflect on observations.

Water Deprivation

1. Dig up a patch of grass and bring it indoors. It may help to put it on a plate or in the lid of the shoe box. Put the patch of grass in direct light, but do not water it.

Light Deprivation

1. Mark off an 8 1/2" x 11" piece of grass. In the students journals have them record observations of plot. Place an 8 1/2" x 11" piece of plywood over a patch of grass.

Change of Light Source

1. Take the large shoe box and remove one of the narrow sides or cut a hole at least 3"x 3" in one of the sides.
2. Place the box over a patch of grass that usually gets full sun during the day. Be careful to replace the shoe box exactly after each observation.

Increased Heat

1. Have students label a clean jar with their name using masking tape. Place jars upside down over an area of grass.

Excess Water

1. Dig up a patch of grass. Place it in an empty plastic food storage container. Add water up to the top of the container and keep the water level constant for 3 weeks.

Heat Deprivation

1. Dig up a patch of grass. Place the patch of grass inside a food container. Place it in a freezer for 3 weeks.

EXTENSION ACTIVITIES

- Grow a sunflower plant and note how the plant changes as the sun passes over it.
- Take a field trip to visit a greenhouse.
- Talk to a produce manager or farmer. Have the students formulate questions about the produce they eat and what conditions are necessary to grow particular items.

QUESTIONS FOR DISCUSSION OR JOURNAL REFLECTION

1. What happens when an organism is deprived of water?
2. What happens when a plant's light supply is cut off?
3. Do all plants suffer when there is no direct light? What about plants that thrive in the shade? How do some plants survive without sunlight?
4. What happens when sunlight direction changes?
5. What happens when plants are given an increased heat source?
6. What if the heat is too intense?
7. What happens after plants get too much water? Discuss flooding and its impact on farmland.
8. What happens to plants when they get too cold? What kinds of plants can survive in very cold climates and temperatures? Discuss what a growing season is.

Observations For Energy For Life

Plant biologist:_____

Conditions being observed:

Prediction:

	Date	Observations
1		
2		
3		
4		
5		

Reflection on observations:

Prediction *(Return to original environment)*:

	Date	Observations
1		
2		
3		
4		
5		

Reflection on observations:

Observaciones Para "Energía Para La Vida"

Biólogo de Plantas:_____

Condiciones observadas:

Predicción:

	Fecha	Observaciones
1		
2		
3		
4		
5		

Reflejos sobre las observaciones:

Predicción *(Regresa al entorno original)*:

	Fecha	Observaciones
1		
2		
3		
4		
5		

Reflejos sobre las observaciones:

INVITATION 7

DECOMPOSITION

BACKGROUND

Every living thing dies. Dying is part of the life cycle. When this occurs, decomposers break down the dead matter, and decay begins. Decomposition holds a very important place in ecosystems and in food chains. Decomposers, such as bacteria and mushrooms, break down organic matter and become food for insects and worms living in the soil. Decomposers, although they are somewhere near the end of the food chain, play a very important role. Through the process of decay, decomposers return nutrients to the soil that provide a source of energy to other living things, particularly plants.

There are certain environments which are conducive to rapid decomposition, while other environments have a composition that causes this process to occur over a longer period of time.

CONCEPTS

- Most foods can be traced back to plants.
- In order for plants and animals to stay alive and prosper, a source of energy is required.
- **Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.**

MATERIALS

- Topsoil
- Cups or small planters, i.e. yogurt containers
- Pieces of organic material, i.e. potato, banana peels, lemon peel
- Copies of page 28 or 29

PROCEDURE

1. In preparation, have students bring in organic material or rescue organic material from the school cafeteria.
2. Have students generate a list of possible environmental conditions that could exist, i.e. hot, moist, and sunny, or cold, damp, and dark, or hot, dry, and sunny. Select three conditions that can easily be simulated in your setting.
3. Put some soil followed by some organic matter. into a cup Alternate layers of soil and organic matter until the cup is full.
4. Place cups in simulated environment. For example, cold, dark and damp could be a cellar or drawer in the refrigerator.
5. Record observations once a week for 6-8 weeks.
6. Report findings to the whole class.
7. Compare and contrast observations from different environments.

QUESTIONS FOR JOURNAL REFLECTION AND DISCUSSION

1. Which environment produced the fastest rate of decay?
2. Which produced the slowest rate of decay?
3. What do the decay rates mean for organisms that depend on decayed matter for energy?
4. How will this affect the nutrients in the soil?
5. What does this mean for the plants?

EXTENSION ACTIVITIES

- Have students identify a section of the country different from that of their experiment. Research the plant life in that region.
- Take a nature walk to find signs of decomposers and decay. Identify signs of new life as a result of the decay.
- Invite a micrologist (mushroom hunter) to class.

OBSERVATIONS OF DECOMPOSITION

Biologist:_____

Describe environment selected:

Describe organic material being observed:

Prediction:

Week	Date	Observations
1		
2		
3		
4		
5		
6		
7		
8		

Reflections:

OBSERVACIONES SOBRE " DESCOMPOSICION"

Biólogo:_____

Describe el entorno seleccionado:

Describe la materia orgánica observada:

Predicción:

Semana	Fecha	Observaciones
1		
2		
3		
4		
5		
6		
7		
8		

Reflejos:

INVITATION 8

PLASTIC OR PAPER?

BACKGROUND

The following table represents approximate rates of decay for common items put in landfills. Do not share this information with students until after predictions and observations have been made.

Vegetable scraps	1-2 weeks
Paper	2-4 weeks
Cloth	1-5 months
Tin can	100 years
Plastic	450 years
Glass	undetermined

CONCEPTS

- Most foods can be traced back to plants.
- In order for plants and animals to stay alive and prosper, a source of energy is required.
- **Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.**

MATERIALS

- One wide-mouth jar per group
- Lid for jar, or plastic wrap to seal it tightly
- Soil--enough to fill each jar at least half full
- Water
- Plastic (i.e. milk bottle pieces)
- Vegetable scraps (i.e. potato, carrot, apple peel)
- Paper scraps cut into 2 in. sq. pieces
- Small cloth scraps
- Wood scraps
- Leaves
- Bits of glass
- Several empty cans
- Copies of page 32 or 33

PROCEDURE

1. Half fill a jar with dirt. Add a small amount of the available items to the jar. The amount should be large enough to be observed over several weeks, but small enough so decay will take place, if possible. Add water to the jar to moisten the soil. All of the items should be mixed thoroughly by shaking the contents of the jar.
2. Have the students predict how long it will take for the different items to decay.
3. Place some of the jars in the sunlight in a warm spot and others in a cool, dark place.
4. Have the students hypothesize what effect the temperature and light will have on the items in the jar.
5. Add water as needed.
6. Make weekly observations of the jars. The contents of each jar can be spread out on a lab tray if the process cannot be observed through the jar.
7. Discuss the type of packaging they choose as consumers. What type of bags do they choose for bagging groceries? How can we make changes in our lifestyles so that the landfill load is decreased? Compare predictions and observations with the table.
8. Have a "Paper or Plastic?" debate.
9. If decomposition is part of the natural energy matter cycle, what impact will so much material that takes generations to decompose have on the future of the planet?

EXTENSION ACTIVITIES

- Take a field trip to a landfill, if there is one in your community.
- Invite a landfill specialist or a sanitary engineer to visit your class.
- Research local landfill, garbage, and recycling issues.
- Have a mock town meeting on the issue of a landfill for the community. Roles may include: environmentalists, shop owners, property owners, town representatives, sanitary engineers, a plastics manufacturer, a paper manufacturer, National Forest Service representatives, school children, fast food chain owners.

HOW LONG WILL IT TAKE ?

Sanitation Engineer:_____

1. What effect do you think temperature has on the role of decay?

2. What effect do you think the amount of light will have on the rate of decay?

	Prediction	Observations
vegetable scraps		
paper		
cloth		
tin can		
plastic		
glass		

¿CUÁNTO TIEMPO ESTARÁ REQUERIDO?

Ingeniero de saneamiento:_____

1. ¿Que piensas será el efecto de temperatura en el decaimiento?

2. ¿Que piensas será el efecto de la cantidad de luz en la marcha de decaimiento?

	Predicción	Observaciones
sobras vegetales		
papel		
tela		
lata		
plástico		
vidrio		

INVITATION 9

DISCOVERING MOLD

BACKGROUND

WARNING: Students with mold allergies should not do this activity.

In order for any organism to grow and remain alive, it must have an energy source. Mold that forms on bread is one of many different types of fungi called Rhizopus. Rhizopus grows on the surface of bread as a cotton-like mass of filaments. In addition to using a substance for food, mold acts as a decomposer. As it feeds from the substance, it begins to break down the substance as well. Certain factors, such as heat and cold, alter the growth stages of fungi development.

This activity demonstrates that mold can grow and flourish in some conditions better than in others. Students will observe that mold needs a source of energy in order to maintain growth.

CONCEPTS

- Most foods can be traced back to plants.
- In order for plants and animals to stay alive and prosper, a source of energy is required.
- **Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.**

MATERIALS

- Loaf of white bread (a slice for each student)
- Aluminum foil
- Paper towel
- Waxed Paper
- Newspaper
- Magnification devices (enough for each student or two students to share): hand held magnifiers, "bug boxes," or microscopes
- Slides for microscope
- Latex gloves
- Safety glasses
- Box of toothpicks
- Copies of page page 36 or 37

PROCEDURE

PART 1:

1. Give each student a slice of bread, a paper towel, and either a piece of foil or waxed paper.
2. Wipe a surface with a piece of bread.
3. Once the bread has been prepared, have the students record the condition of the exposed bread on the observation sheet.
4. Place the slice on a damp paper towel on top of either the foil or waxed paper.
5. Place a few teaspoonfuls of water on the bread.
6. Once "watering" has been completed, wrap the bread, along with the paper towels, with either foil or waxed paper and secure it with tape.
7. Mark the tape with the condition applied to the bread. Phrases like "wiped on windowsill," "patted into dirt," or "waved through the air" will be sufficient. The labeling should be done with a permanent marker.
8. Divide the class into four groups. Have each group store its samples in one of the following locations for two weeks: a freezer, a very warm place (not in direct sun), the direct sun, and at room temperature.

9. Be sure to label each package with the student's name. Have the students record the type of environment into which they have placed their bread slices.

10. In groups, have the students make an educated guess (hypothesis) about what they will see when they open their packages in 2 weeks.

11. Instruct the students not to peek at their specimens during the two weeks.

PART 2:

1. Each student should place a sheet of newspaper on their work space. Supplies needed: 3-4 toothpicks, a magnification device and slides, a sheet of drawing paper, crayons, markers and/or colored pencils. Students should wear latex gloves and safety glasses while handling mold.

2. Open packages very carefully and examine specimens. Use a toothpick and gently scrape off a piece of "bread or mold substance" and view it using a magnification device.

3. Once specimens are viewed and a "good" sample is identified, have students record their observations with a drawing.

4. Once observations are completed, students can assemble with their "group" members and discuss what they found in common and what they found that was different.

5. Once the individual group discussions are completed, the class can assemble and discuss their findings as a whole. Drawings and observations can be shared at this time.

EXTENSION ACTIVITIES

- Have a panel debate for or against mold.
- Read a biography of Alexander Flemming.
- Create a world without mold. What would be the same? What would be different?

OBSERVATIONS FOR DISCOVERING MOLD

Microbiologist:_____

Condition applied to bread:

Type of environment in which bread was placed:

What do you think you will see when you open your package:

Draw what you see without magnification.	Draw what you see with magnification.

Describe in words what your piece of bread looked like after two weeks:

OBSERVACIONES PARA "DESCUBRIENDO MOHO"

Microbiólogo:_____

Condición aplicado al pan:

Tipo de entorno en que el pan fue puesto:

¿Que piensas que verás cuando abrirás el paquete?:

Dibuja lo que ves sin amplificación.	Dibuja lo que ves con amplificación.

Describe como parace el pan despues de dos semanas:

INVITATION 10

FUNGI HUNT

BACKGROUND

Fungi were some of the first organisms to come to land from the sea. Fungi are at least 400 million years old. In some classification systems, fungi are designated as one of the kingdoms. Included in the kingdom of fungi are rhizopus, yeasts, mildews, morels, truffles, toadstools, puffballs, mushrooms, rusts, smuts, cheese mold, and lichens.

Fungi do not carry out photosynthesis because they do not have chloroplasts. They obtain energy and nutrients from other organisms. Mold growing on bread, for example, is actually digesting the bread.

Some fungi break down organic matter by attacking living plants and animals. Other fungi gain their nourishment from dead organisms. Many fungi act as decomposers in the food chain by cleaning up dead plants, animals, and other wastes. They return nitrogen, phosphorus, and other nutrients to the soil.

CONCEPTS

- Most foods can be traced back to plants.
- In order for plants and animals to stay alive and prosper, a source of energy is required.
- **Organisms grow, die, and decay. This process provides the environment for other organisms to grow, die, and decay.**

MATERIALS

- 5" x 7" index cards (enough for every student to have at least 10)

PROCEDURE

This activity is basically a fungi scavenger hunt. Depending on the environment and grade level, the teacher is encouraged to determine the minimum number of drawings of fungi required for the students. All the students should be rewarded for their efforts. This is not a competition, but the students should be encouraged to find more than the minimum number. The teacher might suggest a class goal of 500. The teacher should also suggest variety. Five hundred pictures of the same mushroom is not what is intended here.

If cameras are available, taking pictures could be an alternative to drawings of fungi.

Have the students include some drawings of the environment in which the fungi were found.

Instruct the students not to just copy pictures from books, but to actually try to find a wide variety of fungi. Students should also be cautioned not to touch or taste any fungi, and not to remove fungi from any natural setting.

1. Brainstorm a list of fungi and where different fungi can be found.
2. Tell students that they are going on a fungi hunt for one week. Every time they discover a fungi, they are to draw a picture and/or take a photograph of it, including its surroundings.
3. Set a minimum goal for the students, i.e. at least ten different pictures.
4. Students should verify their findings by checking their drawings in reference books. Each drawing should be accompanied by a journal entry.
5. If students are experiencing difficulty locating fungi, they should be reminded that some breads, beers and wines, and cheeses all contain fungi.
6. At the end of the time allotted for this activity, have students develop a way to classify the drawings or photographs.
7. Display the drawings/photographs on a bulletin board.

8. In their journals have the students reflect on the role of fungi on the earth. What would life be like on the earth if there were no fungi?

EXTENSION ACTIVITIES

- Read about Jean Borel, the Swiss immunologist.
- Investigate the current research on yeast in the control of cancer and AIDS.
- Investigate why lichens are being used to test air quality.
- Invite a bread maker, wine maker, or immunologist to discuss how fungi are used in their work.

MY

SCIENCE

JOURNAL

Scientist's Name_____

MI

CUADERNO

DE

CIENCIA

Nombre del Cientifico_____

Journal Thoughts and Ideas
Invitation_____

Books I've read on this topic

Today I learned...

Cuaderno de Idéas
Sugerencias_____

Libros que he leído sobre este tema

Aprendí hoy..

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